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THE CORRELATION BETWEEN BONE LOSS AND TOOTH MALALIGNMENT.(U)
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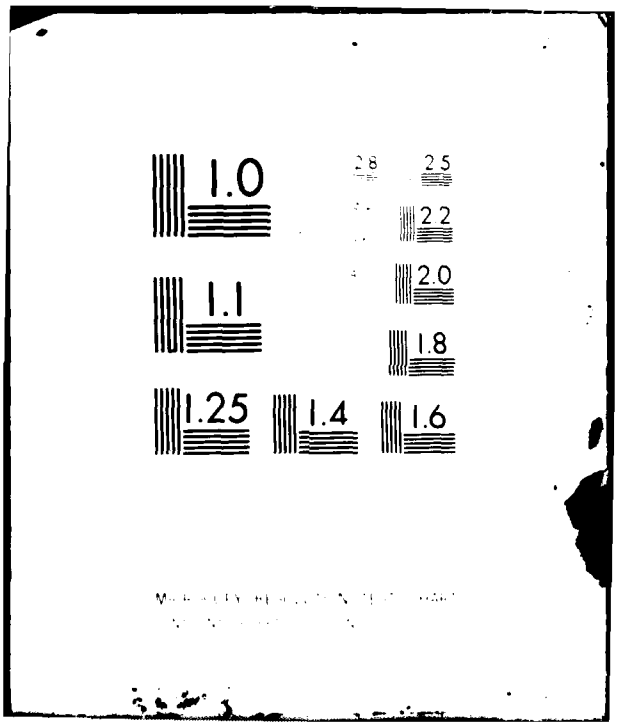
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A dried skull study done on specimens from the Terry collection of the Smithsonian Institution, Washington, DC presents three conclusions: 1) the incidence of malalignment is greater in males and whites than females and blacks; 2) the mandibular centrals and laterals form a separate biological unit from the canines in the incidence and degree of bone loss; 3) the amount of bone loss tends to correlate with the degree of malalignment, agreeing with previous work done using clinical subjects.

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The correlation between bone loss and tooth malalignment

(Running title: Bone loss and tooth malalignment)

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The correlation between bone loss and
tooth malalignment

INTRODUCTION

Malpositioned mandibular anterior teeth may provide a suitable nidus for periodontal disease. Plaque retention, food impaction, occlusal trauma, and root proximity may result from malaligned teeth which can lead to a more rapid periodontal breakdown (Klassman & Zucker 1969). Ainamo reported in 1972 that maxillary anterior teeth showed a significantly positive correlation among increasing scores of malalignment and increasing amounts of plaque, gingivitis, dental calculus, and marginal bone loss. In the mandibular anterior teeth the amounts of plaque, gingivitis, and bone loss were found to increase respectively with increasing malalignment (Gould & Picton 1966, Ainamo 1971, Paunio 1973, Sandalli 1973, Geiger et al. 1974, Schluger et al. 1977)

No study has been done using dry human skulls to correlate periodontal bone loss and the malpositioning of mandibular anterior teeth. In the absence of gingival tissue, a more accurate correlation of periodontal destruction and the position of teeth can be made. The purpose of this study was to investigate the relationship of malposed teeth to severity of periodontal destruction in dry specimens.

MATERIAL AND METHODS

A group of dried human skulls of the Terry Collection, comprised of Modern Americans from St. Louis (1 50 1930), were studied.

The collection is located at the Smithsonian Institution, National Museum of Natural History, Department of Physical Anthropology.

The skulls are of known age, sex, and race with records and information available at the National Museum of Natural History, and represent the dissecting room population of the Anatomy Department of Washington University School of Medicine (St. Louis) from around 1920 to the mid-1960's. This population is almost certainly skewed by age, race, and economic status.

As will be seen from Table 3, age is quite unevenly distributed among the series. At the time the majority of this collection was being assembled, sex and age differences in the social and economic status of the population were considerable. Since age for each of these 4 subpopulations is markedly different in both mean and distribution, one must be on guard against attributing a difference to biological factors such as race or sex which is based more strongly on age or socioeconomic status.

A total of 2300 mandibular anterior teeth were studied from 396 human skulls. Of the 396 skulls, 11 (2.8%) had four mandibular anterior teeth, 54 (13.6%) had five teeth, and 331 (83.6%) had all six mandibular anterior teeth present.

The population of skulls consisted of 128 (32.3%) female skulls of which 24 were Caucasian and 104 were black. There were a total of 268 (67.6%) male skulls studied, 94 Caucasian and 174

black specimens (Table 1).

Grouping the skulls by decades from 10-79 years of age, the largest number of Caucasians studied were between the ages of 30-69 years old. A large segment of the black population studied was between 20-69 years of age (Table 1).

Methods

Skulls were selected to include those with maximum number of remaining teeth. The skulls were evaluated with respect to two criteria, malalignment and alveolar bone loss.

The assessment of malalignment was done by utilizing the Van Kirk and Pennell malocclusion index (Van Kirk & Pennell 1958). Each tooth present in a segment was scored on its degree of rotation or amount of facial-lingual displacement.

0 - no malalignment

1 - minor malalignment

2 - major malalignment

Minor rotation with a score of 1 was determined by an angle of less than 45°. Minor displacement with a score of 1 was determined when both contact areas of the tooth were displaced no more than 1.5mm in the same direction from their position in ideal alignment.

A score of 2 was designated when major rotations of more than 45° and major displacements of more than 1.5mm were found.

Periodontal destruction was measured by using a specially

modified Fox periodontal probe, graduated in millimeters and color coded. The modified probe was used to measure the amount of bone loss on the mesial, distal, facial, and lingual aspects, as malpositioning may affect one area more than another. Measurements were made from the cementoenamel junction to the most apical level of bone, 1mm being designated as a level of crestal bone prior to any periodontal bone loss (Garguilo et al. 1961).

RESULTS

As can be seen in Table 1, age distribution is quite different in the two sexes and races. Most of the younger blacks are men while the older are women. Most of the whites are over 40, with older women predominating.

The distribution of the degree of malalignment by sex and race in the population studied indicated that proportionally a greater number of Caucasions and males had a major degree of malalignment versus a minor alignment being more predominant among blacks and females (Table 2). A composite of all the age groups studied indicated that 54 skulls had no malalignment, 215 skulls had a minor degree of malalignment and 126 of the total 395 skulls were assessed as having major malalignment (Table 3).

The mean and standard distribution of alveolar bone loss for each of the six mandibular anterior teeth by facial, distal, mesial, and lingual surfaces is shown in Tables 4a, b, c, d. The

greatest average mean alveolar bone loss of 3.131mm (s.d. 1.909) was found on the mesial surface of the mandibular anterior teeth. The least average mean bone loss was noted on the distal surface 2.599mm (s.d. 1.697), Table 4d.

The modal value for each tooth by surface measurement is also shown. It is interesting to note that the most consistent measurement on the lingual surface was 2mm for each of the mandibular anterior teeth. The second most frequent measurement of 3mm was found on the facial surface of each of the six anterior teeth measured.

All of these frequency distributions were skewed to the right as indicated by the positive skewness values.

When pairing the cuspids, lateral and central incisors, the average bone loss of the central and lateral incisors was found to be statistically different from the average bone loss of the canine teeth at the .001 level of significance (Table 5). Cuspids demonstrated the least bone loss ($p < .001$), laterals had slightly less bone loss than centrals by only a probability of .07.

A correlation between age and average bone loss resulted in a Pearson's r of -.03935 indicating little or no linear relationship. Attempts to show a linear relationship with age and malalignment as the independent variables produced no significant results.

The average bone loss of all the teeth for each skull

measured ranged from .9 to 7.9mm. When correlating these measurements with the age groups studied, the approximate percent distributions of skulls in each range of measurements is shown in Table 6. In the 12-29 year-old group, the largest number of skulls (34.5%) had an average bone loss of 3.0-3.9mm. An average of 2.0-2.9mm of bone loss was found most consistently in 30% of the skulls examined in the 30-49 year-old group. The most frequent average bone loss, representing 28%, of the 50-69 year-old group was 3.0-3.9mm. Surprisingly, 27.6% of the skulls in the oldest group studied, 70-87 years of age, showed an average of 2.0-2.9mm of alveolar bone loss (Table 8a).

The population of skulls studied showed an increase in the amount of alveolar bone loss in the mandibular anterior teeth as the degree of malalignment increased. As the degree of malalignment increased from minor malalignment to major malalignment, the difference was significant about the 1% level (Table 7).

Tables 8a, b, c show the product moment correlations between bone loss of related, opposing, and adjacent tooth surfaces.

DISCUSSION

The distribution of the sample by age, race, and sex is not in accord with the expected relationships. There is a higher percentage of blacks and females, and the age distributions of the two racial groups are not similar. With this uneven distribution, it is as easy to confuse effects of age, sex or race, as

it is to assign to age an effect that is racial or sexual. Here the significance of race and sex are probably less biological than socioeconomic. Although dissecting room populations rarely include the affluent, there are, nevertheless, internal differences. In this population black males, many of them holding less skilled jobs, still made more money than black women who frequently had to stretch this smaller income to feed more mouths. Similar stratification applies to the Terry collection of whites. With such disparities in possible access to food, medical and dental care, and other basics, there are likely to be significant differences between the sexes and the races that are related less to genetics than to social factors. It would be incorrect to make inferences from this sample except certain areas where the effects of these skewed samples can be ignored.

There are four main conclusions which may be drawn from the data.

1) The low correlation of age and bone loss: this result is almost certainly affected by the irregular nature of the sample. The factors of socioeconomic level, nutrition, education, and health care would all mitigate towards poor periodontal health at a young age and increased mortality rate. It can be theorized that the older people had various health, educational, and nutritional advantages which may have been additive and yielded the artificially low correlation between bone loss and age. For

these reasons, this conclusion is discorded as being influenced by variables outside the scope of this study.

2) The racial and sexual differences in the incidence of malalignment: in Tables 1 and 2, it is shown that females and blacks showed significantly lower percentages of major malalignment than the males and whites. There seems to be no reason to suggest that outside factors of population section would have caused this, and this conclusion seems tenable.

3) Raw data, Tables 4a-d, shows distinct differences between amounts of loss of the different tooth types on different surfaces.

Comparison of teeth by surface and on overall average (Table 7) indicates that mandibular canines (22 and 27) were distinctly different, demonstrating less bone loss than mandibular laterals or centrals. This observation is borne out by the high correlation between adjacent interproximal surfaces (Table 10c). While bone loss on the interproximals of the central and lateral incisors is highly correlated, the correlation between the distal of the lateral incisor and mesial of the canine is much lower (although still statistically significant). Tables 10a and b, which show correlation between related and opposing surfaces, seem to add weight to popular clinical observations that bone loss is more extensive towards the midline and on the facial surfaces. The inference that can be drawn from the data is that the four incisors form a biological "unit", exist in a different periodontal

state, and react to local etiologic factors differently. The bone loss around the canines seems to be of a distinctly different degree (statistically different), and so the canines can be grouped separately from the other anteriors.

4) The correlation of amount of bone loss with the incidence of major malalignment is shown in Table 9. The average bone loss for all surfaces of all teeth was virtually identical for skulls with major or minor malalignment according to the Van Kirk and Pennel index. Skulls with major malalignment showed more bone loss than those with minor alalignment with some tendency towards statistical significance ($p = .07$). This finding agrees with the research of Ainamo (1972) and reinforces the intuitive judgement that malalignment would contribute to increased bone lost.

SUMMARY

A dried skull study done on specimens from the Terry collection of the Smithsonian Institution, Washington, D.C. presents three conclusions: 1) the incidence of malalignment is greater in males and whites than females and blacks; 2) the mandibular centrals and laterals form a seperate biological unit from the canines in the incidence and degree of bone loss; 3) the amount of bone loss tends to correlate with the degree of malalignment, agreeing with previous work done using clinical subjects.

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TABLE 1

Distribution of subjects by race, sex, and age

	Black		White	
Age in Yrs.	Male	Female	Male	Female
Unknown	2	3		
13-19	5	5	1	
20-29	34	19	9	2
30-39	48	26	11	1
40-49	44	15	22	6
50-59	16	17	20	10
60-69	20	9	21	2
70-79	4	7	9	3
80+	1	3	1	
Mean Age	41	43	51	52
n=	174	104	94	24

TABLE 2

Distribution of malalignment by sex and race

		Black	White	All
None-	Male	28	5	33
	Female	19	2	21
	All	47	7	54
Slight-	Male	90	50	140
	Female	58	17	75
	All	148	67	215
Major-	Male	56	39	95
	Female	26	5	31
	All	82	44	126
	Total	277	118	395*

*Data from one skull was lost in data processing.

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Table 3

Malalignment by age

Age	MALALIGNMENT TYPE											
	NONE			MINOR			MAJOR			All	% of total
	n	% of type	% of age	n	% of type	% of age	n	% of type	% of age		
Unknown	0	0	0	4	1.86	80	1	.79	20	5	1.27
13-19	1	1.85	9.09	6	2.79	54.55	4	3.17	36.36	11	2.78
20-29	13	24.07	20.31	34	15.8	53	17	13.49	26.5	64	16.2
30-39	12	22.22	14.11	44	20.46	51.76	29	23.02	34.11	85	21.52
40-49	13	24	14.94	44	20.47	50.57	30	23.81	34.48	87	22.03
50-59	4	7.4	6.35	38	17.67	60.32	21	16.67	33.33	63	15.95
60-69	7	12.96	13.46	28	13.02	53.85	17	13.49	32.69	52	13.16
70-79	3	5.55	18.04	15	6.98	65.22	5	4.00	21.74	23	5.82
80-87	1	1.85	20	2	.93	40	2	1.59	40	5	1.27
n	54			215			126			395	
% of total		13.67			54.43			31.9			

Table 4a

Bone loss on facial surface
(measured in mm)

Tooth		Mode	Median	Mean	s.d.	Skewness	Range
Canines	L	2.00	2.5	2.914	2.304	1.438	0.17
	R	3.00	2.744	3.141	2.478	1.17	0.14
Laterals	L	3.00	2.686	2.808	1.801	.713	0-10
	R	2.00	2.810	3.000	1.817	.802	0-12
Centrals	L	3.00	2.949	3.086	2.001	.720	0-11
	R	3.00	2.970	3.058	1.906	.703	0-10
Average		3.00	2.995	3.103	1.583		

Table 4b

Bone loss on lingual surface
(measured in mm)

Tooth		Mode	Median	Mean	s.d.	Skewness	Range
Canines	L	2.0	1.898	2.013	1.481	.636	0-8
	R	2.0	1.869	2.043	1.646	1.348	0-11
Laterals	L	2.0	2.573	2.722	1.563	.524	0-9
	R	2.0	2.624	2.836	1.732	.781	0-10
Centrals	L	2.0	2.833	3.033	1.876	.586	0-9
	R	2.0	2.789	2.957	1.890	.662	0-10
Average		2.00	2.512	2.660	1.404		

Table 4c

Bone loss on mesial surface
(measured in mm)

Tooth		Mode	Median	Mean	s.d.	Skewness	Range
Canines	L	1.0	2.254	2.576	2.100	.771	0-10
	R	2.0	2.357	2.609	2.001	.782	0-11
Laterals	L	4.0	2.944	3.068	2.133	.576	0-12
	R	4.0	2.968	3.139	2.186	.579	0-10
Centrals	L	2.0	3.286	3.429	2.306	.427	0-12
	R	3.0	3.176	3.366	2.361	.532	0-11
Average		2.00	2.992	3.131	1.909		

Table 4d

Bone loss on distal surface
(*measured in mm*)

Tooth		Mode	Median	Mean	s.d.	Skewness	Range
Canines	L	0	1.114	1.621	1.826	1.279	0-9
	R	0	1.274	1.614	1.670	1.351	0-10
Laterals	L	3	2.829	2.924	2.158	.510	0-11
	R	2	2.647	2.884	2.108	.581	0-9
Centrals	L	3	2.971	3.098	2.196	.557	0-11
	R	2.0	2.732	2.982	2.203	.687	0-10
Average		2.00	2.509	2.599	1.697		

Table 5

Average bone loss of all surfaces and all subjects by tooth type

Tooth Numbers	$\bar{x}$	s.d.
Cuspids	2.322	1.441
	↑	
	p<.001	
	↓	
Laterals	3.017	1.706
	↑	
	p =.07	
	↓	
Centrals	3.216	1.777

Table 6

Average bone loss by age

	Average bone loss of all teeth in mm (% of age)							
Age	0-.9	10-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-7.9	n
Unknown	20%	20%	0	20%	0	20%	0	5
13-19	27	0	0	45+	18+	9	0	11
20-29	15	16	19	26	14	5	5	64
30-39	11	22	23	21	15	5	3	86
40-49	6	17	38	13	20	6	0	87
50-59	13	14	25	29	11	5	3	63
60-69	12	20	18	28	12	8	2	52
70-79	17	9	35	26	4	9	0	23
80-87	20	20	20	20	20	0	0	5
								396

Table 7

Average bone loss by type of malalignment

Malalignment	# of Skulls	Average	s.d.
None	54	2.75185	1.51928
		↕ n.s.	
Minor	215	2.7921	1.56088
		↕ sig at .01	
Major	126	3.05714	1.57888

Table 8a

Correlations of bone loss between related surface

	Facial	Lingual	Mesial	Distal
Canine to Lateral	.4932	.4571	.[illegible]93	.4505
Lateral to Central	.6247	.736[illegible]	.[illegible]93	.79878
Central to Central	.7612	.8233	.[illegible]67	.7556
Lateral to Lateral	.6471	.6852	.[illegible]16	.7605
Canine to Canine	.5036	.4426	.3049	.3710

Table 8b

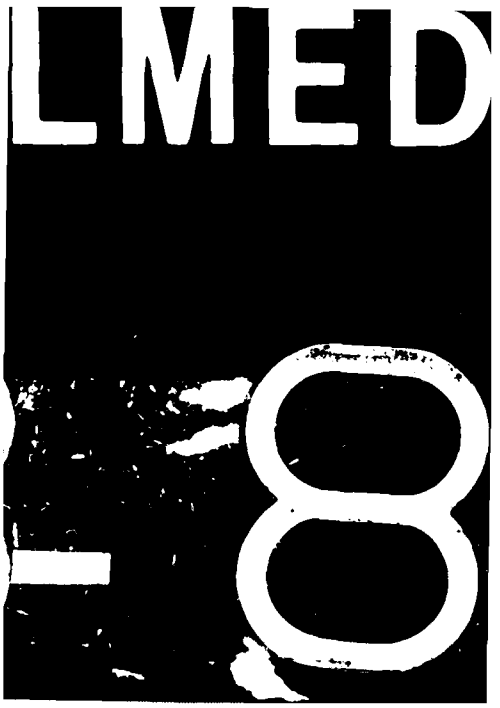
Correlation of bone loss of opposing surfaces

	Facial x Lingual	Mesial x Distal
Canine	.2727	.8411
Lateral	.5886	.8474
Central	.6032	.8621
Overall average	.6844	.9489

Table 8c

Correlations of bone loss
between adjacent surface

m of central x m of central	.8467
d of central x m of lateral	.84954
l of lateral x m of canine	.35985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